AMENDMENTS TO THE CLAIMS

Please amend the claims as indicated hereafter (where underlining "_" denotes additions and strikethrough "-" denotes deletions).

Claims:

Claims 1-17 (Canceled).

18. (Currently Amended) A multiplexer for multiplexing a plurality of variable-rate bit streams onto a medium, the multiplexer comprising:

a receiver for receiving the bit streams;

a transmitter coupled to the receiver for transmitting the bit streams on the medium, each bit stream receiving a dynamically-variable portion of the bandwidth of the medium; and

a bandwidth portion controller coupled between the transmitter and the receiver for dynamically determining the variable portion for each bit stream using an output rate that is obtained by applying a standardized model of a receiver for the bit stream to information read from the bit stream.

19. (Original) The multiplexer set forth in claim 18 wherein:

the bandwidth portion controller determines the output rate for each bit stream such that the receiver for the bit stream will neither overflow nor underflow.

20. (Original) The multiplexer set forth in claim 19 wherein:

the bandwidth portion controller further comprises a queue for each bit stream, the queue being coupled between the receiver and the transmitter and serving to receive the bit stream from the receiver and store the bit stream for output by the transmitter, and

the bandwidth portion controller is further responsive to a state of the queue for each bit stream and further determines the output rate of the bit stream such that the bit stream's queue will not overflow.

21. (Original) The multiplexer set forth in claim 20 wherein:

the bandwidth portion controller further determines the output rate for each bit stream such that the bit stream's queue will not underflow.

22. (Original) The multiplexer set forth in any of claims 18 through 21 wherein:

the bit stream is a sequence of components, the components having varying lengths and each component including timing information indicating when the receiver must process the component; and

the model includes

a current set of components which is the set of the components in the queue together with the set of the components that have been sent to but not yet processed by the receiver,

the timing information for the components in the current set,

the sizes of the components in the current set, and

a size of a bit buffer in the receiver of the model.

23. (Original) The multiplexer set forth in claim 22 wherein:

the components are digitally-encoded video images.

24. (Original) The multiplexer set forth in claim 23 wherein:

the video images are encoded according to the MPEG-2 standard.

25. (Original) The multiplexer set forth in claim 20 wherein:

the bit stream is a sequence of components, the components having varying lengths and each component including timing information indicating when the receiver must process the component;

the model includes

a current set of components which is the set of the components in the queue together with the set of the components that have been sent to but not yet processed by the receiver,

the timing information for the components in the current set,

the sizes of the components in the current set, and

a size of a bit buffer in the receiver of the model; and

the bandwidth portion controller determines the output rate for a given period of time by determining a minimum rate such that each component is output from the queue before the receiver must process the component and a maximum rate such that the total size of the components in the set of the components that have been sent to but not yet processed by the receiver does not exceed the size of the bit buffer in the receiver of the model.

26. (Original) The multiplexer set forth in claim 25 wherein:

the bandwidth portion controller increases the minimum rate for the given time period according to the number of bits that remain in the queue from a current component that is currently being output from the queue and the amount of time remaining until the current component must have been output from the queue and

the bandwidth portion controller decreases the maximum rate for the given time period as the total size of the components in the set of components that have been sent to the receiver and not yet processed approaches the size of the bit buffer in the receiver of the model.

27. (Original) The multiplexer set forth in any of claims 18,19, or 20 wherein:

each bit stream has a priority; and

the bandwidth portion controller further determines the variable portion for each bit stream in accordance with the bit stream's priority.

28. (Original) The multiplexer set forth in any of claims 25 or 26 wherein:

each bit stream has one of a plurality of priorities;

the plurality of priorities includes a first priority according to which each component of the bit stream having the priority will be received in the bit stream's receiver at the time specified for the component; and

where necessary to give a bit stream with the first priority a rate such that each component will be received in the bit stream's receiver at the time specified for the component, the bandwidth portion controller reduces the variable portion for at least one other bit stream which does not have the first priority.

29. (Original) The multiplexer set forth in claim 28 wherein:

the plurality of priorities includes another priority according to which the bit stream's receiver will never underflow; and

where necessary to give a bit stream with the first priority a rate such that each component will be received in the bit stream's receiver at the time specified for the component, the bandwidth portion controller reduces the variable portion for at least one of the bit streams having the other priority to that required to receive at least a minimum component such that underflow will not occur.

30. (Original) The multiplexer set forth in claim 28 wherein:

the plurality of priorities includes another priority according to which the bit stream's receiver may underflow; and

where necessary to gave a bit stream with the first priority a rate such that each component will be received in the bit stream's receiver at the time specified for the component, the bandwidth portion controller reduces the variable portion for at least one of the bit streams having the other priority to nothing.

31. (Currently Amended) The multiplexer set forth in any one of claims 18 through 21 wherein:

the bandwidth portion controller allocates an output rate for each bit stream that is between a minimum rate and a maximum rate obtained by applying the standardized model to the information.

32. (Original) The multiplexer set forth in claim 31 wherein:

the bandwidth portion controller allocates the minimum rate for each bit stream and if bandwidth remains after that is done, allocates a higher rate up to the maximum rate.

33. (Original) The multiplexer set forth in claim 32 wherein:

the bandwidth portion controller allocates the higher rate for each channel in proportion to the difference between the maximum and minimum bit rates for the channel.

34. (Original) Improved apparatus for providing a plurality of variable-rate bit streams to a medium, the apparatus comprising

a plurality of encoders for receiving constant-rate bit streams and producing variable-rate bit streams therefrom and

a transmitter for outputting the bit streams to the medium

and the apparatus having the improvement comprising:

the multiplexer set forth in any of claims 18 through 21, the multiplexer being coupled between the encoders and the transmitter.

35. (Currently Amended) A method of multiplexing a plurality of variable-rate bit streams onto a medium, the method comprising the steps of:

receiving the bit streams;

for each bit stream, dynamically obtaining an output rate by applying a standardized model of a receiver for the bit stream to information read from the bit stream;

for each bit stream, using the output rate determined for the bit stream to dynamically determine a variable portion of the bandwidth of the medium; and

for each bit stream, outputting the bit stream to the medium using the bit stream's variable portion of the bandwidth.

36. (Original) The method set forth in claim 35 wherein:

the output rate is determined such that the receiver of the model will neither overflow nor underflow.

37. (Original) The method set forth in claim 36 wherein the method further comprises the step of:

determining a state of the queue; and

the step of determining the output rate further determines the output rate such that the queue will not overflow.

38. (Original) The method set forth in claim 37 wherein:

the step of determining the output rate further determines the output rate such that the queue will not underflow.

39. (Original) The method set forth in any of claims 35 through 38 wherein:

the bit stream is a sequence of components, the components having varying lengths and each component including timing information indicating when the receiver must process the component,

the model includes

a current set of components which is the set of the components in the queue together with the set of the components that have been sent to but not yet processed by the receiver,

the timing information for the components in the current set,

the sizes of the components in the current set, and

a size of a bit buffer in the receiver of the model, and

the step of determining the output rate is done for a given period of time and comprises the steps of

determining a minimum rate such that the component is output from the queue before the receiver must process the component and

determining a maximum rate such that the total size of the components in the set of the components that have been sent to but not yet processed by the receiver does not exceed the size of the bit buffer in the receiver of the model.

40. (Original) The method set forth in claim 39 wherein:

the step of determining the minimum rate increases the minimum rate for the given time period according to the number of bits that remain in the queue from a current component that is currently being output from the queue and the amount of time remaining until the current component must have been output from the queue and

the step of determining the maximum rate decreases the maximum rate for the given time period as the total size of the components in the set of components that have been sent to the receiver and not yet processed approaches the size of the bit buffer in the receiver of the model.

41. (Original) The method set forth in claim 39 wherein:

the components are digitally-encoded video images.

42. (Original) The method set forth in claim 41 wherein:

the video images are encoded according to the MPEG-2 standard.

43. (Original) The method set forth in any of claims 35, 36, or 37 wherein:

each bit stream has a priority; and

the step of determining the variable portion does so in accordance with the bit stream's priority.

44. (Original) The method set forth in claim 39 wherein:

each bit stream has one of a plurality of priorities;

the plurality of priorities includes a first priority according to which each component of the bit stream having the priority will be received in the bit stream's receiver at the time specified for the component; and

where necessary to give a bit stream with the first priority a rate such that each component will be received in the bit stream's receiver at the time specified for the component, the step of dynamically determining the variable portion reduces the variable portion for at least one other bit stream which does not have the first priority.

45. (Original) The method set forth in claim 44 wherein:

the plurality of priorities includes another priority according to which the bit stream's receiver will never underflow; and

where necessary to give a bit stream with the first priority a rate such that each component will be received in the bit stream's receiver at the time specified for the component, the step of dynamically determining the variable portion reduces the variable portion for at least one of the bit streams having the other priority to that required to receive at least a minimum component such that underflow will not occur.

46. (Original) The method set forth in claim 44 wherein:

the plurality of priorities includes another priority according to which the bit stream's receiver may underflow; and

where necessary to give a bit stream with the first priority a rate such that each component will be received in the bit stream's receiver at the time specified for the component, the bandwidth portion controller reduces the variable portion for at least one of the bit streams having the other priority to nothing.

47. (Original) The method set forth in any one of claims 36 through 38 wherein:

the step of obtaining the output rate obtains a minimum rate and a maximum rate.

48. (Original) The method set forth in claim 47 wherein:

the step of determining a variable portion allocates the minimum rate for each bit stream as the variable portion and if bandwidth remains after that is done, allocates a higher rate up to the maximum rate.

49. (Original) The multiplexer set forth in claim 48 wherein:

the bandwidth portion controller allocates the higher rate for each channel in proportion to the difference between the maximum and minimum bit rates for the channel.

Claims 50-68 (Canceled).